Do Car Drivers Really Need Mobile Parking Payment?

A Critical Evaluation of the Smart Service *apparkB* in Barcelona

Aylin Ilhan(✉), Kaja J. Fietkiewicz, and Wolfgang G. Stock

Department of Information Science, Heinrich Heine University Düsseldorf, Düsseldorf, Germany
{Aylin.Ilhan,Kaja.Fietkiewicz}@hhu.de, stock@phil.hhu.de

Abstract. *apparkB* is a mobile parking payment application, which has been developed and implemented in the city of Barcelona, Spain. We empirically analyzed the awareness of Barcelona's citizens of this service, the users' satisfaction with it and their need to use it. Mobile applications are important services in smart cities, as they support citizens' daily tasks. To critically evaluate *apparkB* we deployed the information service evaluation (ISE) model. In order to get data on *apparkB* we applied an online survey, conducted interviews with Barcelona's smart city authorities, and performed rapid ethnographical field research in April 2016. Only a minority of Barcelona's citizens use this service, as they do not know it or do not use a car in the city. However, those who really use it articulate a need and are satisfied with *apparkB*.

Keywords: Smart service · ApparkB · Smart city · Mobile parking payment · Parking · Mobile service · Persuasive technology · Barcelona

1 Introduction

Why do we need more sustainable and commendable infrastructures in today's everyday life? One possible answer is that "population growth and increased urbanization raise a variety of technical, social, economic and organizational problems that tend to jeopardize the economic and environmental sustainability of cities" [1]. Who matches up to these challenges? For many researchers and practitioners, smart city developers do. They step up to the plate and do not only "monitor, understand, analyze and plan the city", but also create an infrastructure that "improve[s] the efficiency, equity and quality of life" for the people [2]. This article is a case study of the city of Barcelona, which is the 2nd largest city in Spain and is assumed to be one of the smartest cities in Europe [3]. As one of the smart services, Barcelona's citizens have the possibility to use a mobile application called apparkB to pay online for their parking ticket. Annoying situations like running back to the parking automat to prolong the ticket or the searching for the parking automat belong to the past. Which advantages has apparkB? Processes like paying, locating the parked car and prolonging the parking ticket are possible with only one mobile application, every time and everywhere. The basic idea of the smart application is easy to understand; however, do the citizens really use it? Our research is

A. Marcus and W. Wang (Eds.): DUXU 2017, Part II, LNCS 10289, pp. 241–254, 2017.
DOI: 10.1007/978-3-319-58637-3_19

motivated by two questions. Do car drivers really need mobile parking payment? And, are the car drivers satisfied with this smart service?

1.1 Smart City and Smart Services

Up to date there is no clear definition of the term "smart city" and the concept is often characterized as fuzzy. According to Chourabi et al. [4], "the concept is used all over the world with different nomenclatures, context, and meanings." The improvement of the efficiency, sustainability and quality of life are aims of the smart city development projects. Fietkiewicz and Stock [5] summarized the existing definitions and introduced a comprehensive definition of "smart city." There are two sub-concepts – the broad and the narrow one. The latter concentrates on the green sustainable development of a city. Natural resources and energy, transport and mobility, and living conditions are in the main focus [1]. "[S]mart economy, smart people, smart governance, smart mobility, smart environment and smart living" are for Giffinger and Gudrun [6] essential and necessary components of a broader view on a smart city. Additionally, "education, healthcare, public safety" should also be recognized as essential infrastructure components [7]. The smart city in a broader sense is also labeled "Informational City," according to Castell's prototypical city of the network society [8]. Castell's theory defines two kinds of spaces: space of flows (flow of information, capital and power) and space of places (physical entities). Smart city research arrived at a new scientific discipline, namely "informational urbanism" [9].

The "smartness" of a city is defined by cognitive and the digital infrastructures [5]. For this case study, digital infrastructure (the information and communication (ICT) infrastructure) is the determining one. However, the best smart city concept or implementation of ICT is pointless if the citizens as well as the companies are not aware of the transformation of "their" city into a smart city. As Neirotti et al. [1] point out, "cities that are more equipped with ICT systems are not necessarily better cities." Developers require the right and needed ICT systems and smart services that are not isolated from each other and adapted to the needs of a specific target group. "A smarter city should be viewed as an organic whole – as a network, as a linked system" [10]. Cities that are equipped with ICT have three attributes: they are instrumented, interconnected and intelligent [11]. It is important to give the citizens the chance to "participate in the governance and management of the city" [4]. ICT is one – indeed important – aspect, but the use of ICT is another [12].

Mobile payment (m-payment) is a service which can be applied in smart cities [21–23]. M-payment organizes the interconnection between users' "credit or debit cards, phone bills, or prepaid deposits" and the mobile device [24]. It offers a convenient paying method from wireless devices related to different kinds of purchases. The Near Field Communication (NFC) supports m-payment. NFC "mobile payment has been emerging as a noticeable phenomenon that can enable consumers to turn their smartphone into digital wallets" [13]. But not only NFC enables mobile payment, other short-range wireless technologies such as Bluetooth, Infrared Data Association (IrDA) and Radio-Frequency Identification (RFID) enable mobile payment, too [14]. Hu, Li and Hu [15] confirm that users from all over the world appreciate mobile services such as mobile banking and m-payment. PaybyPhone

enables to pay a ticket by mobile phone and makes the traditional parking meter obsolete. Mainetti et al. [16] stressed out that with the upcoming of smart cities intelligent parking systems boast necessity. "Drivers can spend a significant amount of time searching for available spots" [17] while producing and disseminating real-time information to drivers [17]. Related to parking meters, "over the years, the number of parking-system-related technologies has increased" [18]. Fraifer and Fernström [18] introduce different options of smart parking systems, such as Global Positioning Systems (GPS), RFID and other wireless sensor network-based services. With the use of such systems, the user is able to be informed about location and availability of parking spaces [18]. ApparkB is an application of mobile payment used to pay for parking in Barcelona.

1.2 Barcelona

Barcelona has a long history and an infrastructure that developed since centuries. Due to its geographical location, it became the main port, a popular touristic place and one of the leading industrial clusters of Spain. "Barcelona is considered as a success story in urban development across Europe" [3]. The city does not only get attention due to its transformation into a smart city. "The popularity of Barcelona noticeably increased, and it became attractive not only for tourism but also for talented people and business" [32]. Barcelona's path to a smart city is also supported by the fact that the Smart City Expo and World Congress took place for the first time in Barcelona in 2011 [19]. Barcelona's transformation into a smart city is characterized by "having a simple and effective, closer to citizens, connected, ubiquitous, and innovative public (local) administration" [20]. Smart Services in Barcelona represents a broad spectrum, e.g. Barcelona WiFi, Open Government (Open Data), Sharing Bicing Service and intelligent parking services. Some of the smart city programs of Barcelona and the including projects did not only improve the quality of life and the economic growth but also created 1,870 new jobs there [19]. Barcelona transformed its old and obsolete industrial zone "Poblenou" into a digital district, called 22@district [21]. To be equitable towards today's challenges, the 22@ district represent a "new model [of] knowledge urban space that encourages collaboration and synergies between universities, government and companies with the aim of developing innovation and entrepreneurship together with the creation of a good quality of life for its citizens" [21]. Considering the fact of the fast-growing developing progress and implementation of services, the 22@ district creates an "urban laboratory for testing future infrastructure and services" [21], called 22@ Urban Lab. Here, companies get the chance to develop new products and to conduct tests with pilot projects. The focus of these pilots is set on "the environment, energy, mobility, urban development and telecommunication" [22]. Strength of the 22@district, besides promotion of talents, is the enablement of clusters. According to Etzkowitz and Piqué [23], it is important to connect different facilities (like universities, institutions and companies) within one cluster. This way, the collaboration and the flow of knowledge between them is established and supported. Besides technical progress, it is also important to promote the ICT skills. According to Fontova [24], the Media-TIC in the 22@district is characterized as the main central point of the ICT community. Looking at the city's internet presence, it seems that the local government sees the necessity to keep up with other cities and

advanced trends, as it presented a *Digital City Plan* from 2017–2020 with the aim "to drive technological sovereignty for citizens."

1.3 apparkB

The mobile application apparkB enables citizens of Barcelona to pay for their parking time via smartphone. It is freely available both for Android and for iOS users. To use the application to the fullest a registration is necessary. The registration process demands information such as name, personal identification number and approval number of the vehicle. In a next step, one has to enter the bank or credit card information. For the use of apparkB, it is necessary to be connected to the internet. ApparkB users profit from the possibility to prolong the parking time with their smartphone and not at the parking meter on the street. Comfortable paying is also guaranteed. ApparkB's users can prolong the digital parking ticket from everywhere and every time, depending on the parking time conditions. Furthermore, as the application works with GPS, it can help the user to find the parked car. Additionally, the application operates as an alerting service. The user can set the time when he wants to be remained of the remaining parking time. The traffic control checks whether the parked car has a digital parking ticket also with a mobile device [25].

To start the parking time, the user has to open the application, choose the parking zone as well as the vehicle and push the button to start the parking counter. Figure 1 (left) shows that the user has a parking duration of 42 min. To complete the payment and stop the parking the user must click on the blue button. The picture on the right of Fig. 1 shows the location map around the parking lot.

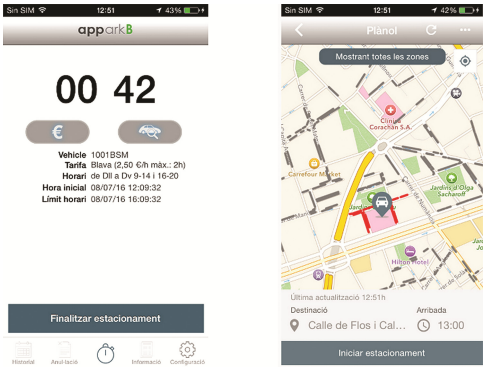

Fig. 1. Surface of apparkB – payment process (left); location map (right). Source: http://apps4bcn.cat/esp/app/apparkb-1/373/ (Color figure online)

2 Methods

The offer of smart services as apparkB in Barcelona does not necessarily have to be successful considering the needs and satisfaction of citizens in smart cities. ApparkB

represents a mobile application that supports the mobile payment and mobile prolonging of parking tickets and the locating of the parked car. Our theoretical model framework enabled us to evaluate users' experience with this application.

2.1 Theoretical Model Framework

We have chosen the Information Service Evaluation (ISE) model [12] (Fig. 2) as our evaluation framework. The dimension 1 (D1) of the ISE model concentrates on information services in general. According to Venkatesh and Davis [26], the success, the adoption and the use of information technology is dependent on two important factors: perceived usefulness and perceived ease of use. Perceived ease of use describes whether a service operates efficiently or not [26]. Referred to the e-commerce, Gefen, Karahanna, and Straub [27] point out that the factor trust is important as well. D1 measures the perceived smart service quality and includes the aspects ease of use, usefulness and trust.

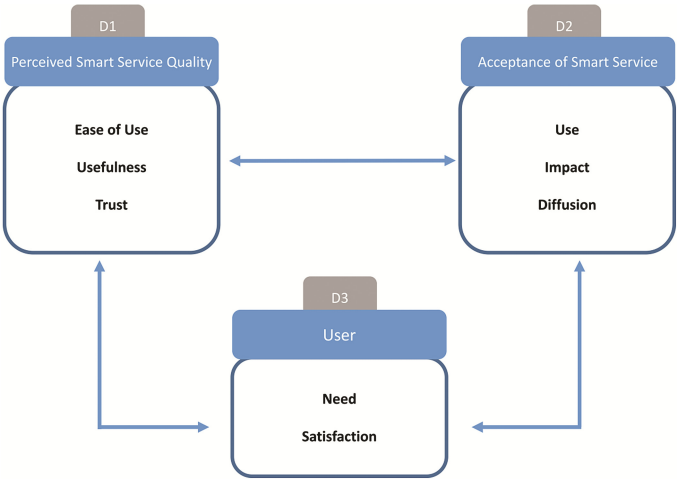

Fig. 2. Our research model

ISE's dimension 2 (D2) represents the acceptance of a smart service. According to Schumann and Stock [12], the dimension of acceptance includes the aspects of adoption, usage, impact and diffusion. It is important to distinguish between adoption and usage. Schumann and Stock [12] describe it concisely: "One can adopt a service and stop to use it. And one can adopt it and use it permanently." Within their evaluation framework, the regular usage in everyday life usually results in behavior changes of some kind. This phenomenon is called impact. If someone accepts a service, uses it and is satisfied with it, then it is likely that he or she will recommend it to friends or family (the so-called 'diffusion'). Every service needs a recommendation, as Venkatesh and Davis [26] explained, that "a superior or co-worker suggests that a particular system might be useful, a person may come to believe that it actually is useful, and in turn, form an

intention to use it." D2 measures the acceptance of a smart service and includes the aspects use, impact and diffusion.

ISE's dimension 3 (D3) represents the residents of a smart city. For our investigation, it is important to find out if there is a correlation between perceived smart service quality and the user's need and satisfaction. The original dimension 'information user' by Schumann and Stock [12] was adapted for this purpose. This case study concentrates on the satisfaction of the users with the service, as it is an important indicator for the product's success. "To avoid wasting resources in this way it is useful to survey the user satisfaction and to use the findings to inform the planning of product development" [28]. Satisfaction includes an element of need, because "if the system does not provide the needed information, the user will become dissatisfied and look elsewhere" [29]. According to Lee and Pow [30], the satisfaction referred to a system is related "to the ease of accessing, learning and using the system, user control, flexibility, robustness, and so on." Therefore, it is necessary to evaluate the satisfaction of users and to analyze the aspects, which deteriorate or improve the satisfaction of a user. Furthermore, Doll and Torkzadeh [31] point out that the analysis of the satisfaction of a user could be compared with different aspects as "content, format, accuracy, ease of use, or timeliness." In this way, the third dimension (D3) in this framework model inquires the subjective satisfaction of the user and his or her needs.

The following research questions (RQs) are either general questions on Barcelona as a smart city and on apparkB's usage (RQ1 and 2) or aspects regarding the interrelationships between the dimensions of the ISE model (Fig. 2); they are the foundation of this investigation.

- RQ1: Background information: How many people in Barcelona realize that they are living in a smart city?
- RQ2: D2/Acceptance of apparkB: How many people use apparkB? How often do they use it? Why do some people refuse to use it?
- RQ3: Are there correlations between the perceived smart service quality of apparkB (D1), the acceptance of this smart service (D2) and the user characteristics in terms of needs and satisfaction (D3)?

2.2 Practical Framework

In order to answer the three research questions an online survey was developed and distributed in Barcelona using social media and e-mail contacts. The online survey was based on a seven-point Likert scale (1 – "Strongly disagree" up to 7 – "Strongly agree").

Furthermore, to understand the progress and concept of Barcelona's smart city it was essential to conduct a case study combined with a rapid ethnographical field research before the survey was developed. Case studies are used to develop a theory based on the executed case study. The data collected in a recently executed case studies leads to a theory based on "novelty, testability, and empirical validity, which arise[s] from the intimate linkage with empirical evidence" [32]. A case study is a good way to gather information on unexplored or marginally explored research fields and develop a theory based on the gathered data. Furthermore, the case study "is useful in early stages of

research on a topic or when a fresh perspective is needed, while the latter is useful in later stages of knowledge" [32]. The aim of this case study is to find out if the residents of Barcelona use some of the smart services, if so, how often do they use them and why, or what are the reasons for not using the services. The results of the research are of importance for either improving or implementing smart city services in other cities or countries, especially pertaining to their advantages or disadvantages. The case study and the ethnographical field research, which is "a style of research that lays down the procedural rules for how to study people in naturally occurring setting or 'fields' by means that capture their social meaning and ordinary activities" [33] enables a real impression about the city, citizens and services by being on location. We conducted a "rapid" ethnography. Baines and Cunningham [34] describe the rapid ethnographical research as "a form of multi-method ethnography involving data collection from numerous sources over a relatively short period including interviews, participant observations, document review and sometimes surveys and focus groups." According to Millen [35], the rapid ethnographical field research has the potential "to provide a richer field experience for a smaller amount of time in the field."

Both strategies, the case study as well as the ethnographical field research, employ interviews as a research method. Qu and Dumay [36] point out that this kind of method is one of the strongest ones to collect qualitative data. The interviews with authorities responsible for the Barcelona smart city strategy and services enable a good understanding of the goals and vision of the project. The semi-structured interview method includes prepared questions, which are "guided by identified themes in a consistent and systematic manner interposed with proves designed to elicit more elaborate responses" [36].

Barcelona was visited in April 2016 for eight days, and nine authorities of Barcelona's smart city services were interviewed on-site. Additionally, 131 participants from Barcelona completed the questionnaire.

3 Results

3.1 Perceived Smartness of Barcelona (RQ1)

It is interesting to analyze if residents living in Barcelona also know that their city is labeled as a smart city and what a smart city is exactly. Figure 3 shows that 57% of 131 participants know that Barcelona is labeled as smart city and 49% have basic knowledge on the definition of a smart city. Since even researchers are not in agreement about smart city's definition, this is a surprising result.

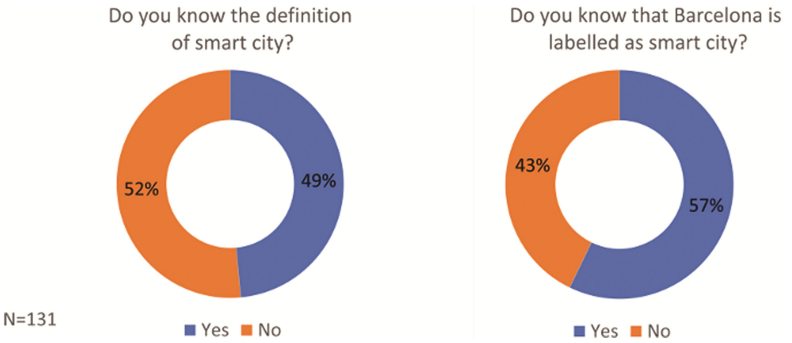

Fig. 3. Awareness of smart city definition and Barcelona being a smart city

3.2 Usage of apparkB (RQ2)

Related to apparkB, Fig. 4 shows that only 8% do actually use the application for paying their parking ticket or to locate their parked car. 27% do know the application, but do not use it. Why do most respondents do not use apparkB? Many participants (62%) do not know the app. Other participants stated that they do not need the app, as they do not drive into the city or only use free parking places (Fig. 5). Other occasionally mentioned reasons are that the participants are not satisfied with the application as it does not work properly or that the application requires too much personal information.

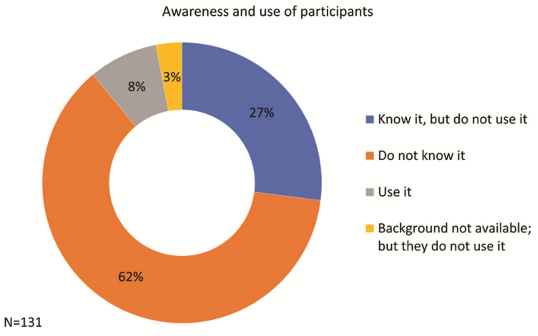

Fig. 4. Using distribution related to apparkB

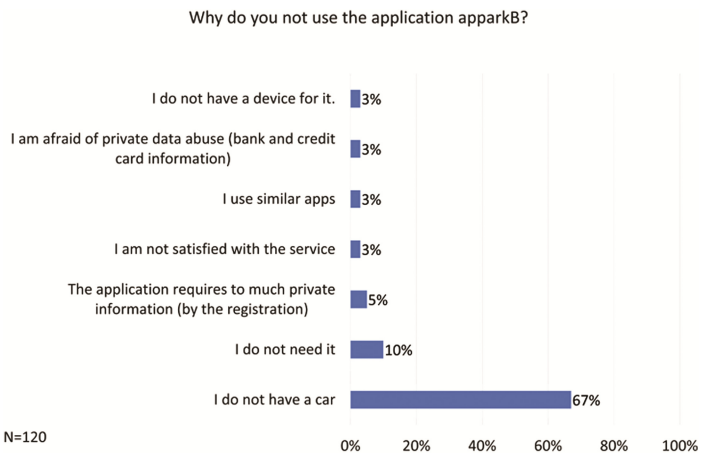

Fig. 5. Reasons for rejecting the apparkB; multiple answers were possible (non-users only)

Figure 6 shows that two out of eleven active apparkB customers use the application several times a day (18%). The second most used time interval is several times a week. 18% of the customers use the app once a week. However, the majority of participants use apparkB less than once a week (36%).

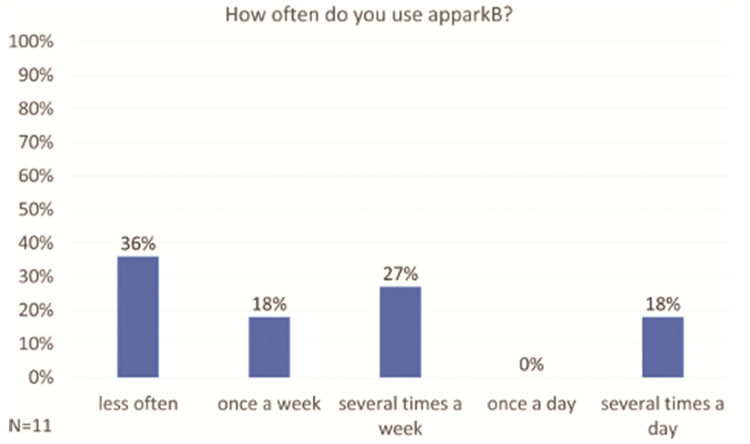

Fig. 6. Use distribution related to apparkB (users only)

Now we arrive at users' assessment of the apparkB project. For the analysis of each statement listed in Fig. 7, the median values were computed. The statements about apparkB generate an impression how the participants perceived the service's impact and functions. Participants confirm the usability of the application as they agree that it is easy to use (median: 6). Also, the service of locating the parked car is very well received (6). The customers nearly always confirm that the payment via the application does work without technical problems (6). However, apparkB does not offer the feature of finding

a free parking space (3), and users would welcome such a service. One of the project's main impacts is the replacement of the manual parking meter (7). The function to prolong a ticket does not fully convince the residents, when looking at the median value (4.5). However, participants emphasize the usability of the app, since prolonging the parking ticket with the application is easier than with the manual parking meter (6). It is easy to register as a user (6). Furthermore, the users have no trust problems to transmit the credit card and bank information (6). The participants confirm that the application satisfied their demands (6). They would recommend the service to friends or family members that do not know it (6). In the end, the participants totally agreed that they would recommend apparkB for other cities, too (7).

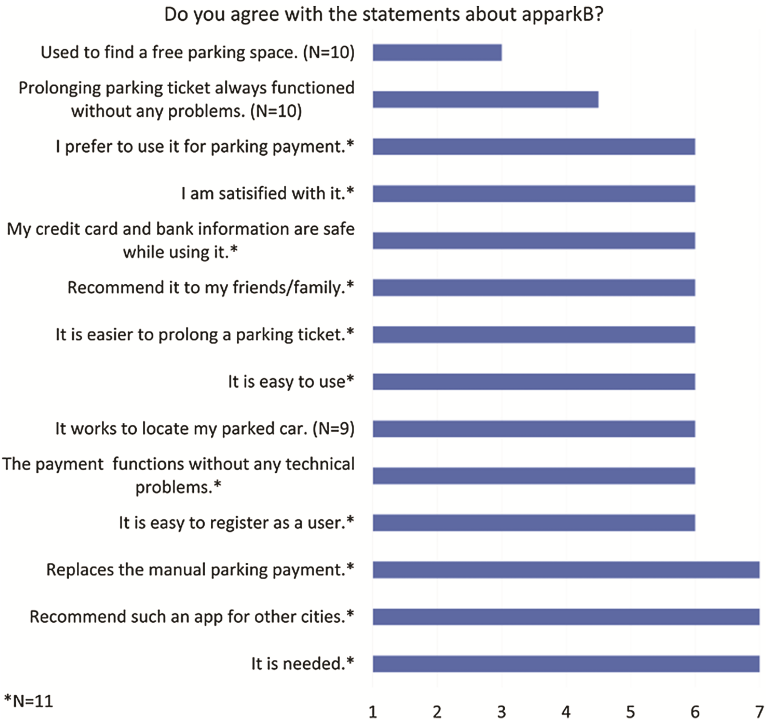

Fig. 7. Statements on apparkB (users only)

3.3 Correlations Between apparkB's Perceived Quality, Acceptance and Users' Characteristics (RQ3)

The survey included several different questions about the apparkB. The internal consistency of the dimensions was tested with Cronbach's α. A positive correlation has to be interpreted bidirectional as the variance is not calculated by deeper analysis. As our data are on an ordinal scale, we calculated a rank correlation applying Spearman's rho.

Is there a rank correlation between the perceived smart service quality (D1) and the acceptance of smart service (D2)? The only indicator from D1 that significantly

correlates with indicators of D2 is *Usefulness* (+.654* with *Impact*, +.730* with *Diffusion* and even +.762** with *Use*) (Table 1). The more apparkB is perceived as useful, the more it is used, has more impact and tends to diffuse into society, generally, the more it is accepted. Perceived ease of use only plays a minor role when it comes to acceptance of this smart service. Considering the correlations between D1 and D3 (user), again *Usefulness* is essential. It correlates significantly with both, *Satisfaction* (+.614*) as well as *Need* (+.759**). The more apparkB is perceived useful the more it is satisfying and meets the users' needs.

Table 1. Bivariate rank correlation (Spearman's rho) between perceived smart service quality (D1), smart service acceptance (D2) and user (D3)

	Dimension 1			Dimension 2			Dimension 3	
N = 11	Ease of use	Usefulness	Trust	Use	Impact	Diffusion	Need	Satisfaction
Ease of use	1	.544	.206	.130	.481	.332	.337	.564
Usefulness	.544	1	.244	**.762****	**.654***	**.730***	**.759****	**.614***
Trust	.206	.244	1	−.010	.257	.333	.306	.366
Use	.130	**.762****	−.010	1	.298	**.785****	**.845****	.276
Impact	.481	**.654***	.257	.298	1	.234	.394	**.629***
Diffusion	.332	**.730***	.333	**.785****	.234	1	**.824****	.579
Need	.337	**.759****	.306	**.845****	.394	**.824****	1	.393
Satisfaction	.564	**.614***	.366	.276	**.629**	.579	.393	1

* p < .05, ** p < .01, *** p < .001

For indicators of D2 and D3, there is a strong correlation between *Need* and *Use* (+.845**), *Need* and *Diffusion* (+.824**) as well as between *Satisfaction* and *Impact* (+.629*). The more apparkB is needed by the users the more the customers will use it and it will diffuse to new users. The more users are satisfied the more impact apparkB has on them. Additionally, there is an important significant correlation between two indicators within dimension 2. *Diffusion* highly correlates with *Use* (+.785**), meaning the more apparkB is used the more it will diffuse into society. If a smart service as apparkB satisfies the users' needs, it is perceived as useful. Usefulness in turn has strong relations to use, impact and diffusion. Ease of use and trust only exhibit weak relations to acceptance.

4 Discussion

Rapid ethnographical field research and semi-structured interviews showed that Barcelona is not overloaded with high number of ICT services. ICT related services are merely implemented in areas where the residents really need them. One interviewee defined this idea as "the development and implementation of a symmetrical infrastructure." Being able to decide, if services need to be implemented in specific areas is important to avoid unnecessary costs and to ensure the maximum benefit for the citizens.

The critical evaluation of the service apparkB in Barcelona shows that only a minority of the participants use this application, because the majority simply has no car in the city (it is not fun to drive in Barcelona). Nevertheless, 8% of all our participants

are satisfied with the smart city service and do need it. Obviously, apparkB satisfies those users' needs and leads to its use. Based on the outcomes of the survey, it is not the missing satisfaction, the trust or the ease of use why people avoid the application. The pivotal question is, "is there a need to drive and to park in the city?" Citizens in metropolises often use public transport possibilities and leave the car at home. Traffic jam, no parking places or too expensive parking spaces are typical motives to not use a car. During the rapid ethnographical field research, we observed a lot of citizens using a bicycle or public transport possibilities. They obviously do not need apparkB. It also raises the question, whether smart city projects should encourage car holders to drive into the city, by offering such applications. Smart city idea is also linked to a sustainable development and green city infrastructure. Therefore, it is more advisable to allocate the resources and ICT technology to developing a more efficient public transport, supporting car-sharing, or use of alternatives to the own car. Making the usage of cars in the city center easier with help of parking applications contradicts this idea. Divorced from the smart city context, it is indeed a good and convenient alternative to manual parking meters.

Nevertheless, by using and implementing ICT (like the introduced mobile applications) manual procedures like parking meters become obsolete. As today the most people have a mobile phone, developers use this possibility to improve the life quality by simplifying the daily tasks. In the current state of technology, a mobile phone is not only a device for communication it also could be used as a digital wallet, since payment for parking time is possible. Additionally, the results show that parking applications do not only offer a comfortable payment, but also prolonging of the parking time and ticket.

This research makes clear that the critical evaluation of services in smart cities is not only a "nice" option but rather a necessity. With the use of evaluation models, developers and researchers get a feedback, if the citizens really need such services. Furthermore, our research shows that the success of a service depends on different indicators, including the users' needs, the service's perceived usefulness, its impact on users' behavior, and the extend of use.

References

1. Neirotti, P., De, M.A., Cagliano, A.C., Mangano, G., Scorrano, F.: Current trends in smart city initiatives: some stylised facts. Cities **38**, 25–36 (2014). doi:10.1016/j.cities.2013.12.010
2. Batty, M., Axhausen, K.W., Giannotti, F., Pozdnoukhov, A., Bazzani, A., Wachowicz, M., Ouzounis, G., Portugali, Y.: Smart cities of the future. Eur. Phys. J. Spec. Top. **214**, 481–518 (2012). doi:10.1140/epjst/e2012-01703-3
3. Bakici, T., Almirall, E., Wareham, J.: A smart city initiative: the case of Barcelona. J. Knowl. Econ. **4**, 135–148 (2013). doi:10.1007/s13132-012-0084-9
4. Chourabi, H., Nam, T., Walker, S., Gil-Garcia, J.R., Mellouli, S., Nahon, K., Pardo, T.A., Scholl, H.J.: Understanding smart cities: an integrative framework. In: Proceedings of the Hawaii International Conference on System Sciences, pp. 2289–2297. IEEE Computer Society (2011)
5. Fietkiewicz, K.J., Stock, W.G.: How "smart" are Japanese cities? An empirical investigation of infrastructures and governmental programs in Tokyo, Yokohama, Osaka, and Kyoto. In: Proceedings of the Hawaii International Conference on System Sciences, pp. 2345–2354. IEEE Computer Society (2015). doi:10.1109/HICSS.2015.282

6. Giffinger, R., Haindlmaer, G.: Smart cities ranking: an effective instrument for the positioning of cities? Archit. City Environ. **4**, 7–25 (2010)
7. Washburn, D., Sindhu, U.: Helping CIOs understand "smart city" initiatives. Forrester Research (2009)
8. Castells, M.: The Informational City: Information Technology, Economic Restructuring and the Urban-Regional Process. Blackwell, Oxford (1989). doi:10.2307/2073712
9. Stock, W.G.: Informational Urbanism. Syst. Cybern. Inf. **13**, 62–69 (2015)
10. Kanter, R.M., Litow, S.S.: Informed and interconnected: a manifesto for smarter cities. Harvard Business School Working Paper, No. 09-141 (2009)
11. Harrison, C., Eckman, B., Hamilton, R., Hartswick, P., Kalagnanam, J., Paraszczak, J., Williams, P.: Foundations for smarter cities. IBM J. Res. Dev. **54**, 1–16 (2010). doi:10.1147/JRD.2010.2048257
12. Schumann, L., Stock, W.G.: The information service evaluation (ISE) model. Webology **11**, 1–20 (2014). doi:10.3233/ISU-140759
13. Pham, T.T.T., Ho, J.C.: The effects of product-related, personal-related factors and attractiveness of alternatives on consumer adoption of NFC-based mobile payments. Technol. Soc. **43**, 159–172 (2015). doi:10.1016/j.techsoc.2015.05.004
14. Leong, L.Y., Hew, T.S., Tan, G.W.H., Ooi, K.B.: Predicting the determinants of the NFC-enabled mobile credit card acceptance: a neural networks approach. Expert Syst. Appl. **40**, 5604–5620 (2013). http://dx.doi.org/10.1016/j.eswa.2013.04.018
15. Hu, X., Li, W., Hu, Q.: Are mobile payment and banking the killer apps for mobile commerce? In: 41st Hawaii International Conference on System Sciences, pp. 84–94. IEEE Computer Society (2008)
16. Mainetti, L., Marasovic, I., Patrono, L., Solic, P., Stefanizzi, M.L., Vergallo, R.: A novel IoT-aware smart parking system based on the integration of RFID and WSN technologies. Int. J. RF Technol. **7**, 175–199 (2016). doi:10.3233/RFT-161523
17. Nawaz, S., Efstratiou, C., Mascolo, C.: Smart sensing systems. Pervasive Comput. **15**, 39–43 (2016). doi:10.1109/MPRV.2016.22
18. Fraifer, M., Fernström, M.: Investigation of smart parking systems and their technologies. In: Thirty Seventh International Conference on Information Systems. IoT Smart City Challenges Applications (ISCA 2016), Dublin, Ireland, pp. 1–14 (2016)
19. Gascó, M.: What makes a city smart? Lessons from Barcelona. In: HICSS 2016 Proceedings of the 2016 49th Hawaii International Conference on System Sciences, pp. 2983–2989. IEEE Computer Society (2016)
20. Gascó, M., Trivellato, B., Cavenago, D.: How do southern European cities foster innovation? Lessons from the experience of the smart city approaches of Barcelona and Milan. In: Gil-Garcia, J.R., Pardo, T.A., Nam, T. (eds.) Smarter as the New Urban Agenda. PAIT, vol. 11, pp. 191–206. Springer, Cham (2016). doi:10.1007/978-3-319-17620-8_10
21. Piqué, J.M., Pareja-Eastaway, M.: Knowledge cities on smart cities: transferring the 22 @ Barcelona model. In: 30th IASP World Conference on Science and Technology Parks - Work. 2 new role STPs Driv. city Chang. Recife, Brazil, pp. 1–14 (2013)
22. Majó, A.: 22@Urban Lab, the example of Barcelona. In: Col·legi d'Economistes de Catalunya (ed.) Knowl. Econ. Territ., 64th edn. Revista Econòmica de Catalunya, pp. 101–105 (2014)
23. Etzkowitz, H., Piqué, J.M.: 22@ Barcelona: a knowledge city beyond science parks. In: Catalunya C d'Economistes de (ed.) Knowl. Econ. Territ., 64th edn. Revista Econòmica de Catalunya, pp. 171–182 (2014)
24. Fontova, R.: The Media-Tic building, a "medusa" in 22@ (2009). http://lameva.barcelona.cat/bcnmetropolis/arxiu/en/page43d3.html?id=22&ui=304&prevNode=33&tagId=23

25. Ajuntament de BarcelonalBarcelona de Serveis Municipals SA ApparkB. https://www.areaverda.cat/en/operation-with-mobile-phone/apparkb/
26. Venkatesh, V., Davis, F.D.: A theoretical extension of the technology acceptance model: four longitudinal field studies. Manage. Sci. **46**, 186–204 (2000). doi:10.1287/mnsc.46.2.186.11926
27. Gefen, D., Karahanna, E., Straub, D.W.: Trust and TAM in online shopping: an integrated model. MIS Q. **25**, 51–90 (2003)
28. Bramwell, B.: User satisfaction and product development in urban tourism. Tour. Manage. **19**, 35–47 (1998). doi:10.1016/S0261-5177(97)00091-5
29. Ives, B., Olson, M., Baroudi, J.: The measurement of user information satisfaction. Commun. ACM **26**, 785–793 (1983). doi:10.1145/358413.358430
30. Lee, M.K.O., Pow, J.: Information access behaviour and expectation of quality: two factors affecting the satisfaction of users of clinical hospital information systems. J. Inf. Sci. **22**, 171–179 (1996). doi:10.1177/016555159602200303
31. Doll, W.J., Torkzadeh, G.: The measurement of end-user computing. Manage. Inf. Syst. Q. **12**, 259–274 (1988). doi:10.2307/248851
32. Eisenhardt, K.M.: Building theories from case study research. Acad. Manage. Rev. **14**, 532–550 (1989). doi:10.5465/AMR.1989.4308385
33. Brewer, J.: Ethnography. Open University Press, Buckingham (2000)
34. Baines, D., Cunningham, I.: Using comparative perspective rapid ethnography in international case studies: strengths and challenges. Qual. Soc. Work. **12**, 73–88 (2013). doi:10.1177/1473325011419053
35. Millen, D.R.: Rapid ethnography: time deepening strategies for HCI field research. In: Proceedings of the Conference on Designing Interactive Systems: Processes, Practices, and Methods Techniques, pp. 280–288. ACM New York (2000). doi:10.1145/347642.347763
36. Qu, S.Q., Dumay, J.: The qualitative research interview. Qual. Res. Acc. Manage. **8**, 238–264 (2004). http://dx.doi.org/10.1108/11766091111162070